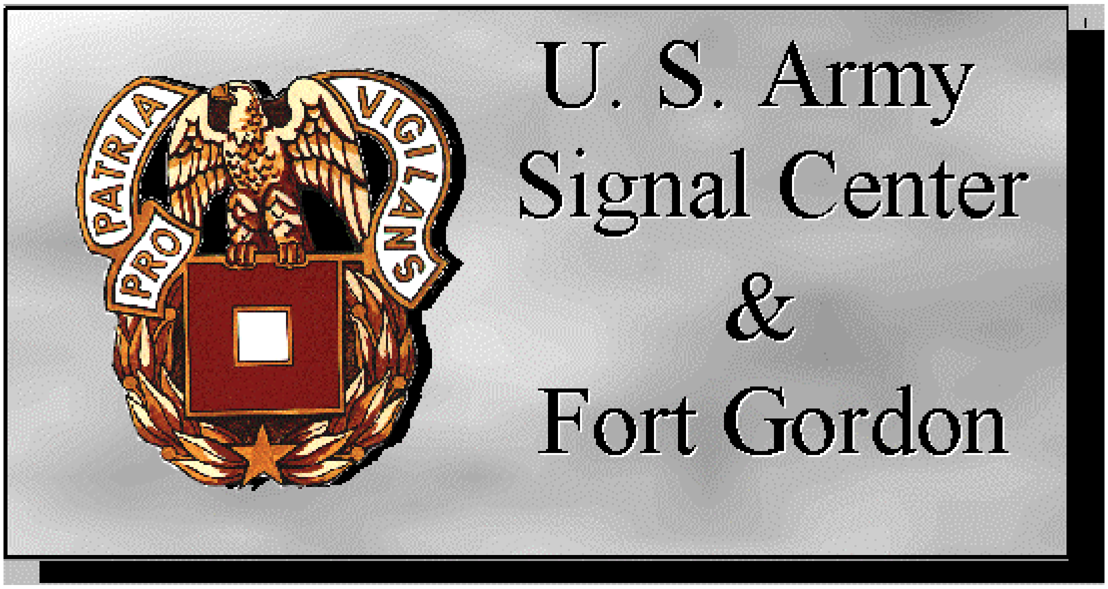
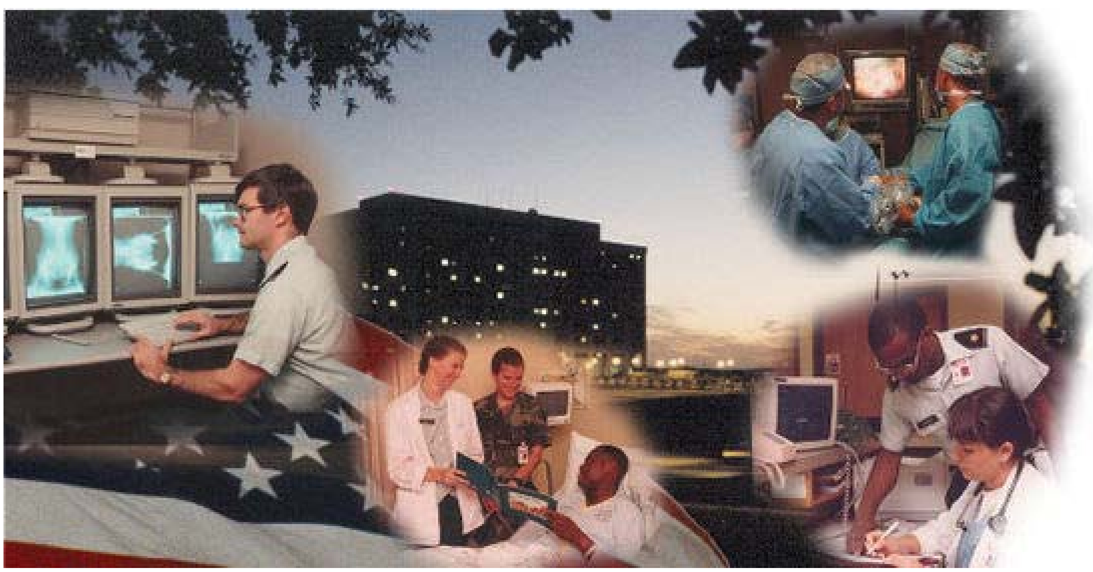




LOGANEnergy Corp.

Initial Report Fort Gordon Demonstration Program

Fort Gordon FY'02 PEM Demonstration Project

Augusta, Georgia

January 30, 2004

Contents

Table of Figures

Introduction

Fuel Cells convert the chemical energy of a fuel into useable electric and thermal energy without an intermediate combustion or mechanical process. In that respect, they are similar to batteries. However, unlike batteries, fuel cells oxidize externally supplied fuel and therefore do not need recharging. Ever since National Aeronautics and Space Administration (NASA) adopted fuel cell power for the Apollo Space program, American industry has been fascinated by the prospects for their use on earth as well.

When integrated with a fuel processor and a solid-state power conditioner, the fuel cell power system becomes one that produces clean, quiet and reliable electric power and heat. Several manufacturers are currently hard at work to translate the basic technology into consumer products. As advances in PEM technology and mass production converge to introduce competitively costs systems into the marketplace, many are betting that small-scale fuel cell generators will soon be ready to tackle thousands of residential and small-scale commercial power applications. These new appliances will be packaged energy systems providing both heat and electricity that will be able to operate with or without the local utility grid.

Until recently, however, the promise of fuel cell technology has been slow to advance beyond a narrow beachhead commonly referred to as the "early adopter" marketplace. Broader market appeal has been constrained by fits, false starts and premature expectations raised by eager manufacturers; but also high prices, skepticism, and not a little resistance by parochial interests have all restricted the opportunity. Notwithstanding, during the decade of the 1990s, the UTC PC25C Fuel Cell program, assisted by a significant DOD investment, gradually established a solid record of achievement and customer satisfaction at numerous US locations and around the world. Installations sites included military hospitals, commercial buildings, banks, food processing facilities, data processing centers, police stations, and airports.

While many of these "early adopters" hosted pure technology demonstration projects, the industry gained valuable experience and knowledge because of them. More recently, however, customers have warmed to the proposition that fuel cells have real performance advantages in various combined heat and critical power applications (CHP). Perhaps their attitudes and business practices may be adjusting to accommodate an uncertain energy landscape. Clearly, many energy providers are scrambling to maintain their market base, others are floundering, and still others are stalking new opportunity. Nevertheless, they are all discovering that informed consumers have gained new leverage through the power of choice. Increasingly, newspaper articles, periodicals and other media outlets are scoring direct hits with stories about fuel cells. Policy makers are out front raising expectations of a cleaner, highly efficient fuel cell/hydrogen based economy of the future. The signals are clear. Initiative and momentum are driving a rapidly maturing fuel cell industry.

Certainly one reason is because fuel cell technology represents, perhaps, the most exciting and innovative development in the energy industry today. In some ways the technology is maturing more rapidly and markets are developing more quickly than the supporting infrastructure, codes and standards are able to accommodate. However, as technology demonstrations increasingly give way to CHP fuel cell installations that provide practical solutions to demanding consumer requirements, such roadblocks should get resolved as consumer and utility interests find common ground. For example, in most applications, large-scale fuel cell installations may off-load significant power resources during critical grid demand intervals, serving utility interests, while providing "hot" back-up for mission essential loads in commercial and even residential applications. Additionally, they may also provide Btus for heating and cooling loads-demonstrating the dual benefits of enhancing grid stability and promoting energy conservation.

At the small scale and residential end of the fuel cell spectrum, the opportunity is just as promising for the rapid expansion of distributed power generation. Conceivably, thousands of 3kW to 5kW CHP fuel cells in homes and small businesses across the country could within several years displace hundreds of MWhs of electricity and millions of Btus with clean, efficient and reliable energy service. If this occurs, it could have a dramatic impact on both the energy industry, and on the nation's economy and security. Consumers, not utilities, could begin displacing environmentally disruptive generation methods, thereby forcing changes in the industry. As providers of grid resources, they may one day collectively enhance grid stability in many areas, boosting efficiency and conservation norms, and having a decided impact on the evolution of national energy policy.

Against this backdrop, the US Army Corps of Engineers Construction Engineering Research Lab (CERL) has contracted with LOGANEnergy through its FY'02 PEM Demonstration Program to engage a progressive fuel cell energy strategy to inform future DOD policy and planning. Broadly speaking, this engagement directs LOGAN to purchase and install residential and small-scale fuel cell power plants, and then test and evaluate their performance in widespread applications at selected military installations. Three events make this program very timely. They are (a) the complexities and perplexities of utility deregulation juxtaposed with, (b) base utility privatization programs, and (c) the nascent interest in distributed generation / CHP technologies that promise more efficient utilization of resources.

If the fuel cell industry appeared very much ahead of a languid power market in the recent past, today those markets are in comparative turmoil. Prices and availability, in some cases, are volatile and beyond the comprehension of energy managers and consumers alike. Consumers who are seeking innovative and efficient energy solutions for greater comfort, convenience and reliability are adding a new urgency. If the fuel cell industry can capitalize on these conditions, it will have a rich market opportunity, but it will have to deliver energy services and benefits that are immediate, site specific, cost effective, energy efficient, and certifiably green!

In order to test and evaluate the state of PEM fuel cell technology against these challenges, LOGANEnergy Corporation will demonstrate over the course of a year a PEM small-scale fuel cell at Fort Gordon, GA. The project will be guided by an operations plan that will direct the installation, testing, evaluation and reporting on the performance of the unit. The objectives of the plan include;

1. Evaluating installation methods in order to help standardize safe and cost effective installation practices,
2. Evaluating "out of the box" reliability and interoperability with existing facility electrical and mechanical systems / infrastructure,
3. Evaluating actual PEM operating characteristics as compared to manufacturer representations,
4. Measuring the cost of operating a PEM unit under real market conditions,
5. Measuring, collecting and analyzing operating data including, total load hours, availability, kW production, fuel consumption, water consumption, forced outages, serviceability, and manufacturer's support.
6. Introducing PEM technology, power distribution and energy efficiency to DOD and local stakeholders in the community.

The project will be led by LOGANEnergy and supported by the Fort Gordon Advanced Power Technology Office, Plug Power and Energy Signature Associates.

Fort Gordon PEM Site Selection and Installation

Figure 1, Army University of Technology Resource Center

In October 1995 LOGANEnergy first met with met with Mr. Curtis Oglesby, Chief Engineer of the Directorate of Public Utilities at Fort Gordon. The purpose was to try to interest Fort. Gordon in siting a fuel cell there with the financial assistance of DOD Climate Change Funds. That early initiative did not materialize, but LOGAN continued to maintain a cordial relationship with Mr. Oglesby over the ensuing years.

In preparation for the FY'02 CERL PEM Demonstration Program submittal, LOGAN approached Mr. Oglesby with the idea of submitting Fort Gordon for a PEM demonstration project in June 2002. Fort Gordon site did not make the first cut, but in August 2003, CERL notified LOGAN that additional funds would be available to move forward with the Fort Gordon project.

In December 2003, Fort Gordon hosted a project kick-off meeting that was attended by representatives of CERL, LOGAN and representatives of the Directorate of Public Works. At the meeting, Mr. Glen Stubblefield, Fort Gordon project engineer, announced that the site selection team had changed the project site from the Garrison Commander's residence to the Army University of Technology Resource Center, building 40201. Mr. Stubblefield explained that the Commander had just decided his residence should not serve as the project site. Following the meeting, the group toured the new site and met with the information technology staff who were all very pleased with the change of venue. On January 14, 2004 Plug delivered GenSys SN#246 fuel cell to Fort Gordon.

Figures 1 and 2, above and at right, are photos of the front entrance and rear, respectively, of the Fort Gordon Army University of Technology Resource Center, building 40201. The rear view shows the facility's gas service outside the mechanical room doorway also captured in the view. The fuel cell pad will occupy the space just to the right of the gas meter.

Figure 2, Pad Site at Rear of Building

Figure 3, at left, is a view of the service panel in the mechanical room, noted above, that distributes power throughout the Technology Resource Center. The fuel cell will be wired to the panel in a spare cubicle housing a 60Amp circuit breaker. A critical load panel will be placed nearby and LOGAN will transfer critical 110vac Server and UPS circuits to the new panel. These loads will be powered by the fuel cell in the event of grid failure on the base during the one-year demonstration period.

Figure 3, Electric Service Panel

Figure 4, at the right, is a view of the Technology Resource Center server room. A UPS that has approximately 15 minutes of battery back up currently protects the system. This is sufficient to allow the facility to go through a controlled shutdown following a power failure. The new critical load panel to be installed with the fuel cell will support the UPS rectifier circuit to keep the Resource Center online during power failures.

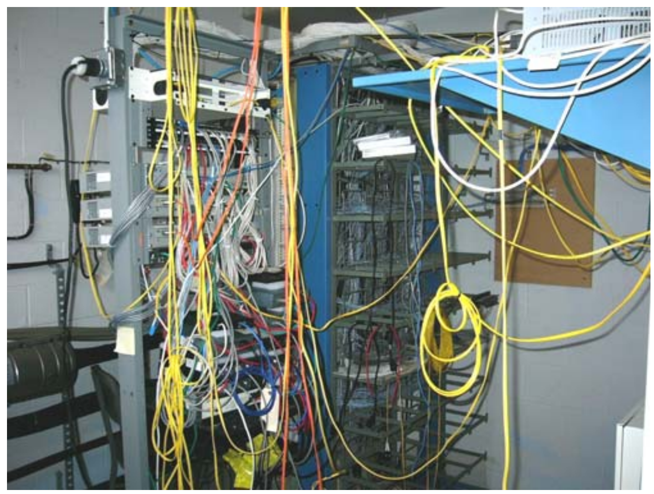


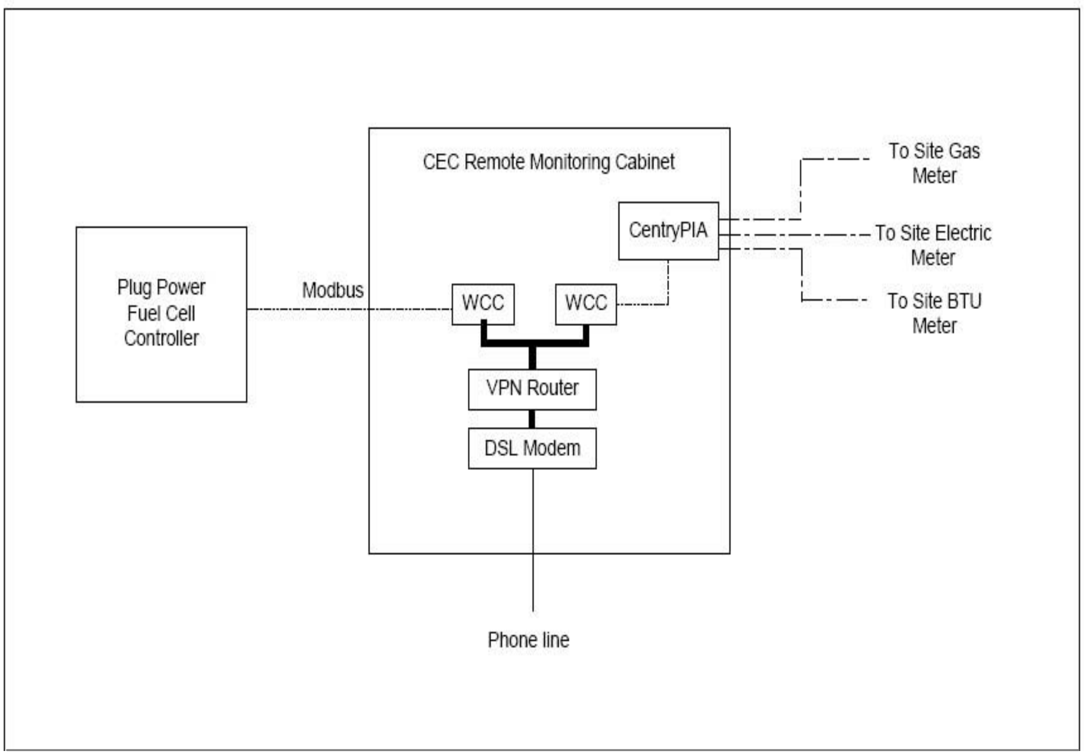
Figure 4, Server Room

The utility pole mounted transformers, seen at left in Figure 5, are a typical means of providing service to clusters of small buildings on DOD facilities. This is the same service configuration that LOGAN encountered at its Fort Jackson project where fuel cell power was available to the two adjacent homes served by the other two pole mounted transformers. Similarly, fuel cell power provided at the Resource Center will be available to the adjacent buildings.

Figure 5, Utility Feed to the Resource Center

Site Communications Package

Following is the drawing of Connected Energy equipment necessary to commission Plug Power fuel cell genset sites in order to communicate with a remote and central data center securely via the Internet. One CENTRYWCC communicates with the Plug Power controller, and another CENTRYWCC is dedicated to interface with the site meters and sensors via CENTRYPIA. The CENTRYPIA allows communication with multiple pulse or analog inputs. The VPN router at the site encrypts the traffic between the site and the data center to make a very secure connection, similar to what banks use to send financial information over the Internet. The modem is optional. If the site allows for direct network access, no modem is necessary (see cost reduction discussion following). Other modems can be used at sites where access or cost drives alternative communication strategies to DSL.



Once the system is operational, real time operating and performance may be viewed at https://www.enerview.com/EnerView/login.asp. The login id is *logan.user* with a password of *guest*. Then click on the 4th District Coast Guard box.

Figure 6, Fuel Cell Virtual Private Network (VPN) Communications Pack

Installation Line Diagram

Fort Gordon PEM Installation Line Diagram

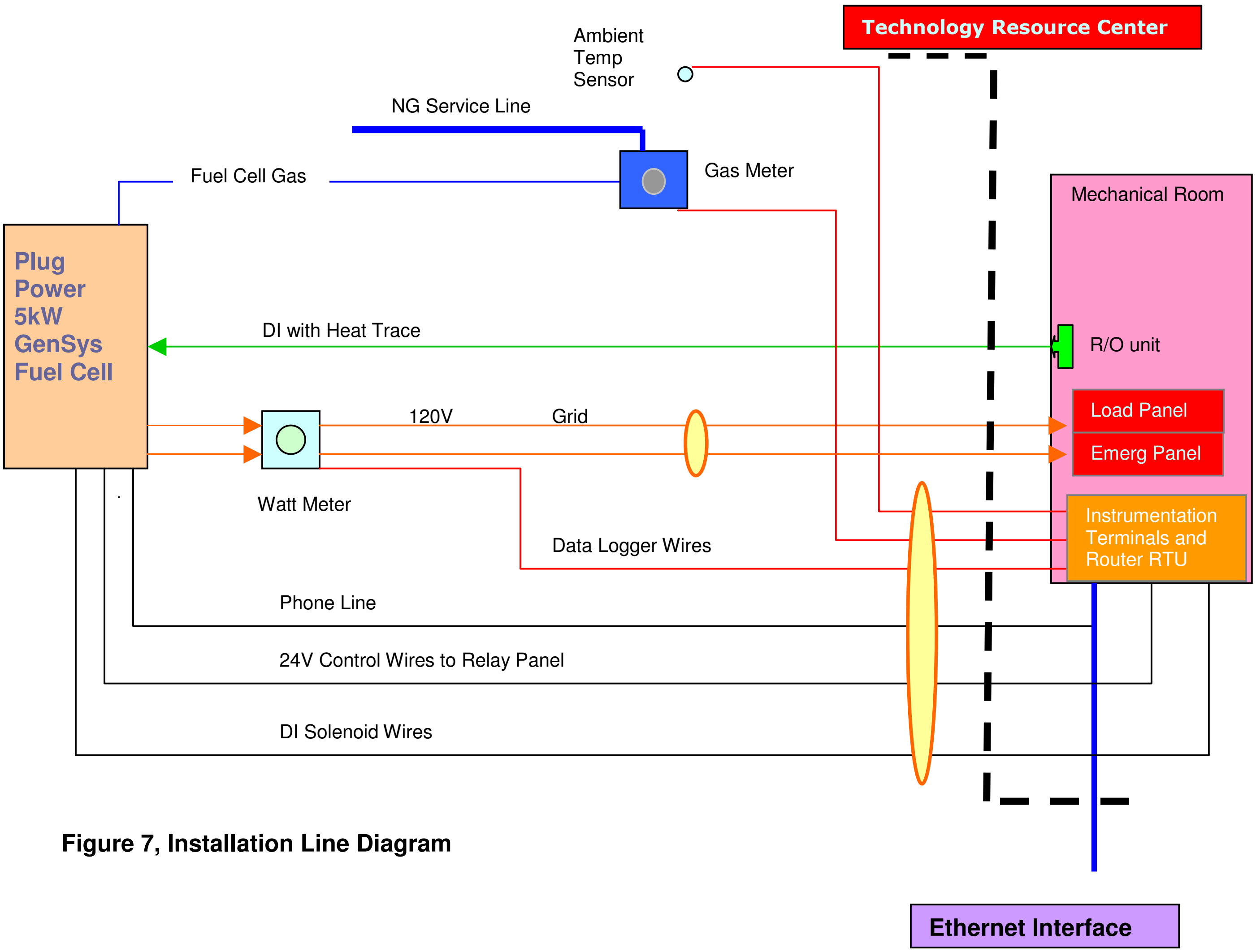
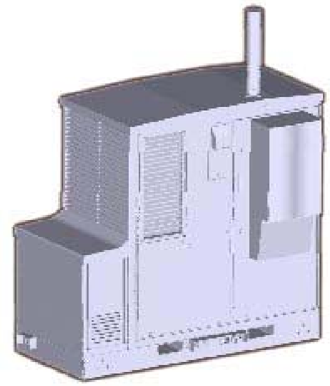


Figure 7, Installation Line Diagram

Plug Power GenSys 5C PEM Fuel Cell Plant



Specifications

Physical	Size (L X W X H):	84 1/2” X 32” X 681/4”
Performance	Power rating:	5kW continuous
	Power set points:	2.5kW, 4kW, 5kW
	Voltage:	120/240 VAC @ 60Hz
	Power Quality:	IEEE 519
	Emissions:	NO_X < 5ppm
		SO_X < 1ppm
		Noise < 70 dBa @ 1meter
Operating Conditions	Temperature:	0°F to 104°F
	Elevation:	0 to 750 feet
	Installation:	Outdoor/CHP
	Electrical Connection:	GC/GI
	Fuel:	Natural Gas
Certifications	Power Generation:	CSA International
	Power Conditioning:	UL
	Electromagnetic Compliance:	FCC Class B

Dimensions

Length	84 inches
Width	32 inches
Height	68 ¼ inches

Operating Requirements

Fuel Type	Natural Gas
Temperature	0 degrees F to 104 degrees F

Outputs

Power Output	5kW
Voltage	120/240 VAC @ 60Hz
Noise	< 70 dBA@ 1 meter

Certifications

CSA International	Fuel Cell System
UL1741	Power Conditioning Module
IEEE P1741	Grid Parallel Generation

Figure 8, Product Specifications

Installation Application

Figure 6, above, describes a one line diagram for the Fort Gordon fuel cell installation. The diagram illustrates utility and control interfaces including, gas, power, water and instrumentation devices that will be installed in the adjacent mechanical room of the Technology Resource Center. Figure 8, above, lists the specifications of the Plug Power GenSys5C PEM technology demonstration fuel cell chosen for this site.

Judging from the initial site evaluations, the electrical conduit runs between the facility load panels and the fuel cell will be approximately 15 feet. The Reverse Osmosis/DI water tubing run that provides filtered process water to the power plant will also be 15 feet distance. LOGAN had planned to demonstrate fuel cell waste heat recovery and integration into the host site as a part of this project. Unfortunately, the late venue change from the Commander's residence to the University Resource Center, which has no appreciable thermal load, precludes that opportunity. Data logging and resources management will be accomplished with the Connected Energy communications package in Figure 7 above.

The fuel cell inverter has a power output of 110/120 VAC at 60 Hz, matching the building distribution panel in the mechanical room with its connected loads at 110/120 VAC. The installation includes both a grid parallel and a grid independent configuration described above in Figures 2 and 3. The unit will provide stand-by power to a new 50amp critical load panel that will supply emergency power to the server loads in the Technology Resource Center. This will assure that University students stationed across the earth will have continuous access to the on-line lesson plans maintained in the Center. A two-pole wattmeter will monitor both the grid parallel and grid independent conductors to record fuel cell power distribution to both the existing panel and the new critical load panel.

LOGAN will connect the fuel cell to the existing natural gas service piping seen in Figure 2 above. A new gas meter will be installed on the service line to the fuel cell to independently calculate fuel cell gas consumption. To complete the installation a regulator at the fuel cell gas inlet will maintain the correct operating pressure at 14 inches water column.

A phone line connection with the fuel cell modem provides communications with Plug Power and LOGAN customer support functions.

The installation will follow an approved plan that will insure minimal inconvenience to the base or the host site.

Permitting

LOGAN will work closely with the Fort Gordon Directorate of Public Utilities to insure that the installation will conform to all environmental requirements. At this point only a digging permit will be required to proceed with the installation.

Start-up and Commissioning

The first start should occur by mid March 2004. Prior to starting the unit, LOGAN technicians will closely adhere to the Installation Checklist items covered in Figure 9, below. In addition all items in the Commissioning Checklist, listed in Figure 10 below, will be followed insure smooth and reliable performance before the technician departs the site.

Service incidents and facility calls will be reported on the sample Service Call Report form listed below as Figure 11.

An Economic Analysis of the Fort Gordon AFB project appears in Figure 12 below.

Installation Check List

TASK	SIGN	DATE	TIME(hrs)
Batteries Installed			
Stack Installed			
Stack Coolant Installed			
Air Purged from Stack Coolant			
Radiator Coolant Installed			
Air Purged from Radiator Coolant			
J3 Cable Installed			
J3 Cable Wiring Tested			
Inverter Power Cable Installed			
Inverter Power Polarity Correct			
RS 232 /Modem Cable Installed			
DI Solenoid Cable Installed with Diode			
Natural Gas Pipe Installed			
DI Water / Heat Trace Installed			
Drain Tubing Installed			

Figure 9, Installation Check List

Commissioning Check List

TASK	SIGN	DATE	TIME (hrs)
Controls Powered Up and Communication OK			
SARC Name Correct			
Start-Up Initiated			
Coolant Leak Checked			
Flammable Gas Leak Checked			
Data Logging to Central Computer			
System Run for 8 Hours with No Failures			

Figure 10, Commissioning Check List

LOGANEnergy

Service Call Report

SERVICE CALL REPORT

System Serial #:________________________

SYSTEM INFORMATION

Date:____________________________

Purpose of Service Call ☐Repair ☐Maintenance ☐ECN (Check all that apply)

	Date	Time
Date/Time shutdown	____________	____________

MAINTENANCE / REPAIR INFORMATION

Service Tech Name: ________________________

Travel Man-hours: ________________________

Troubleshooting Man-hrs: ________________________

Repair Man-hours: ________________________

Spare Part Delay Time: ________________________

Work Performed: ________________________

Technician

Comments: ________________________

FAILURE REPORT SUMMARY

Date	Description of Problem	Rpt #	Initials

Figure 11, Service Call Report

Ft Gordon, GA PEM Fuel Cell Economic Analysis

Estimated Project Utility Rates	
1) Water (per 1,000 gallons)	$1.69
2) Electricity (per KWH)	$0.0651
3) Natural gas (per MCF)	$6.25

Estimated First Cost	
Plug Power 5 kW GenSys5C	*$65,000*
Shipping	*$2,800*
Installation electrical	*$2,275*
Installation mechanical	*$0*
Watt Meter, Instrumentation, Web Package	*$9,650*
Site Prep, labor materials	*$925*
Technical Supervision	*$8,500*
Total	***$89,150***

Assume Five Year Simple Payback	**$17,830**

Forcast Operating Expenses	Volume	$/Hr	$/ Yr
Natural Gas			
Mcf/hr @ 2.5kW	*0.032838*	*$0.21*	*$1,618*
Water			
Gals/Yr	*4918*		*$8.31*

Add Total Annual Operating Costs	**$1,626**
Total Annual Costs (Ammortization + Expenses)	**$19,456**

Economic Summary		
Forcast Annual kWH	*19710*	
Annual Cost of Operating Power Plant	*$0.0825*	kWH
Credit Annual Thermal Recovery	*0*	kWH
Project Net Operating Cost	*$0.0825*	kWH
Ammount Available for Financing	*($0.0174)*	kWH
Add 5 Yr Ammortization Cost / kWH	*$0.9046*	kWH
Demonstration Cost to the Local Command	**$0.0825**	**kWH**
Current Demo Program Cost Assuming 5 Yr Simple Payback	**$0.9871**	**kWH**

***NOTE**Does not include allowance for cell stack life cycle costs or service over 5 year economic senario*

Figure 12, Economic Analysis

Project POC List

Fort Gordon PEM Fuel Cell Demonstration Program

Fort Gordon Program Manager
Chief Facilities Engineer
Curtis D. Oglesby
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Fort Gordon Project Engineer
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Fort Gordon Site Communications Support
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Fort Gordon RTI IT Manager
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DoD Fuel Cell Program Manager
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LOGANEnergy Installation Manager
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Connected Energy Data Communications Manager
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kevin.hann@connectedenergy.com

Plug Power Project Engineer
Brian Davenport
(518) 727-4553
brian_davenport@plugpower.com

Figure 13, Project POCs

Site Location

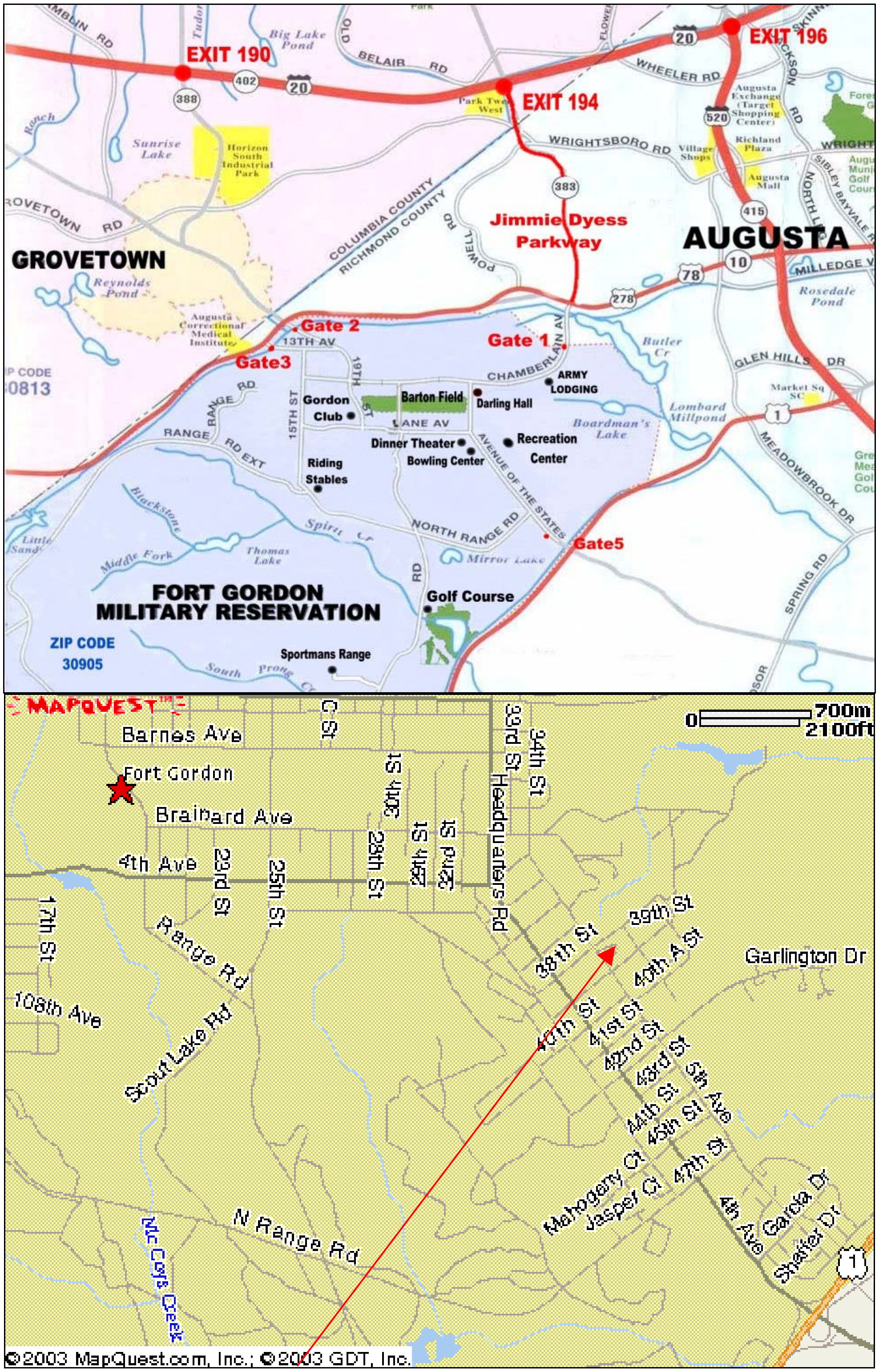

Figure 14, Fort Gordon Fuel Cell Site Location

Installation Safety Plan

LOGANEnergy Corp.

Project Description	Activity Date
Ft Gordon Fuel Cell Demonstration Project...Electrical and Mechanical Installation of Plug Power GenSys5C 5kW PEM Fuel Cell Power Plant .	Months of Feb/March 2004

Installation Site	Project Manager	Prepared By
Army University of Technology Resource Center, Building 40201 Fort Gordon, GA	LOGANEnergy Corp. 1080 Holcomb Br Rd 100 Roswell Summit, Suite 175, Roswell, GA 30076	Samuel Logan, Jr. **Date** 01/31/04

Project Personnel

Ft. Gordon Project Mgr.	LOGAN Project Manager/Representative	Emergency Medical Response
Glen Stubblefield (706) 791-6184	**Name** Mike Harvell (803) 635-5496	Univ Medical Center, 1350 Walton Way, Augusta, GA

Project Contractors	Other Personnel	Specialized Equipment for Tasks
LOGANEnergy	See POC List Above	Fork Truck, Thermal Welder, Power Drill, Various Power Tools

Installation /Construction

Tasks	Perils	Mitigation
1. Hand Trench 10 feet 1/2" NG Line	Cut/damage other buried utilities, conduit, lines	Locate and Mark buried utilities before trenching.
2. Hand trench 15' water line.	Cut/damage other buried utilities, conduit, lines	Practice correct tie-in techniques, use trained personnel.
3. Offload 2,200 PEM Fuel Cell	Damage Equipment, harm/injure personnel.	Use trained equipment operators with trained observers.
4. Electrical/Mechanical Installation	Electric Shock to personnel. Injury or harm working with power tools.	Use "LOTO" procedures; avoid working "HOT" circuits Use trained personnel on all installation tasks.
5. Initial Start of Equipment	Damage Equipment, harm/injure personnel.	Use factory trained personnel, follow procedures.
6. Maintain General Site Conditions	Unkempt Site...Danger to residents and visitors.	Remove loose materials, tools, police site at end of each day. Place yellow caution ribbon around installation/work areas.
7. Maintain Safe Work Environment	Injury, loss of equipment, materials, customer dissatisfaction, loss of time and money.	Manager's Representative to encourage safe practices by all contractor personnel; critique unsafe practices; and lead by example.
8. Personnel Safety	Head, hand and foot injury.	Construction/installation crews shall wear appropriate personal protective gear while performing job site tasks.

Figure 15, Safety Plan